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L5	L4 and (fischer near1 tropsch or liquid near1 hydrocarbon\$1)	15	L5
L4	L3 and (synthesis gas or carbon monoxide near1 hydrogen)	15	L4
L3	L2 or l1	18	L3
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L5: Entry 2 of 15

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Aug 29, 2002

DOCUMENT-IDENTIFIER: US 20020120017 A1

TITLE: Processes for the production of hydrocarbons, power and carbon dioxide from carbon-containing materials

Abstract Paragraph (1):

Apparatus and processes for producing power, liquid hydrocarbons and carbon dioxide from heavy feedstocks, using a partial oxidation reactor to produce a synthesis gas, a Fischer-Tropsch reactor to convert the synthesis gas to hydrocarbon products and tail gases containing hydrogen and carbon dioxide, and a combined cycle plant to produce power from steam generated by recovering heat from the reactors and from combustible tail gases. By varying operating conditions and utilizing hydrogen for recycle to the Fischer-Tropsch reactor and/or hydrocracking wax products to produce lighter hydrocarbons, the process can selectively maximize the production of power, hydrocarbons or carbon dioxide. In preferred embodiments, the Fischer-Tropsch reactor can be a slurry reactor and can employ an iron-based catalyst.

Summary of Invention Paragraph (2):

[0002] This invention relates to improved processes for the conversion of carbon-containing liquid and solid feedstocks into valuable liquid hydrocarbon products by subjecting the feedstock to partial oxidation, to produce synthesis gas and converting the synthesis gas into valuable products using a Fischer-Tropsch reactor and an iron-based catalyst. In these processes, high carbon feedstocks are converted to relatively low carbon fuels and the excess carbon dioxide is separated. The production of power, carbon dioxide or hydrocarbons can be selectively maximized to provide greater operational flexibility and economic return.

Summary of Invention Paragraph (10):

[0009] A significant fraction of the crude oil fed to a refinery consists of heavy material generally having a high content of sulfur. This material is oftentimes an environmental liability to the refinery with high disposal costs. Recently it has been considered that a more economical solution to the problem is to convert the heavy crude oil to synthesis gas using partial oxidation (POX).

Summary of Invention Paragraph (15):

[0012] The synthesis gas can then be used as fuel in a gas turbine to generate electrical power. An example of this approach is the api Energia S.p.A integrated combined cycle plant (IGCC) described in the Dec. 9, 1996 issue of the Oil & Gas Journal. In many instances, it is not desirable or practical to use all of the synthesis gas produced in the POX reactor for production of electricity. In these instances it may be desirable to convert some or all of the synthesis gas to liquid hydrocarbons which are free of aromatics and sulfur using Fischer-Tropsch (FT) chemistry. The Fischer-Tropsch (FT) synthesis reaction is expressed by the following stoichiometric relation:

Summary of Invention Paragraph (17):

[0013] The aliphatic hydrocarbons produced by the Fischer-Tropsch reaction have an H:C atom ratio of 2.0 or greater.

Summary of Invention Paragraph (18):

[0014] Fischer-Tropsch catalysts such as iron-based composites also catalyze the water gas shift (WGS) reaction:

Summary of Invention Paragraph (22):

[0017] Due to the relatively low hydrogen content of the heavy crude oil, any FT catalyst useful in converting synthesis gas produced by partial oxidation of heavy

crude oil must possess some water gas shift activity. Therefore, modern cobalt-based FT catalysts which have very little WGS activity cannot generally be used when the POX feedstock is a heavy crude oil, coke or coal. However, iron-based catalysts as described in U.S. Pat. No. 5,504,118 have high WGS activity and are preferred for use with low-hydrogen feedstocks.

Summary of Invention Paragraph (23):

[0018] For a natural gas feedstock which has a high H:C ratio, U.S. Pat. Nos. 5,620,670 and 5,621,155 teach that carbon dioxide recycle back to the synthesis gas producing step (either POX or steam reforming) decreases the excessively high H.sub.2:CO ratio of the synthesis gas and increases the yield of Fischer-Tropsch (FT) hydrocarbons and the attendant carbon conversion efficiency.

Summary of Invention Paragraph (24):

[0019] In the case of low H:C ratio feeds, steam reforming is not a viable means for producing synthesis gas due to the inevitable formation of carbon when using these high carbon feedstocks. Carbon deposition on a reforming catalyst cannot be tolerated. Also, solid fuels are unsuitable for steam reforming. Thus, the only viable option for gasifying high C:H feeds is POX.

Summary of Invention Paragraph (26):

[0021] Another means for increasing the hydrocarbon yield and carbon conversion efficiency of a system is to recycle part of the tail gas to the inlet of the POX unit. However, the amount of tail gas recycle is limited by the resulting low H.sub.2:CO ratio in the synthesis gas produced in the POX caused by the large amount of CO.sub.2 in the tail gas.

Summary of Invention Paragraph (27):

[0022] The use of combined partial oxidation and Fischer-Tropsch reactors permits the conversion of a variety of high-carbon solid and liquid fuels to liquid hydrocarbons and other products which have lower C:H atom ratios and can thus be combusted or otherwise used with net lower emissions of carbon dioxide to the atmosphere. In the present invention, carbon dioxide can be efficiently removed from tail gases in the process and sequestered to reduce the net carbon dioxide emissions. Due to environmental and political considerations, there is increasing interest in reducing carbon dioxide emissions associated with combustion energy, and in trapping and sequestering such gases as are emitted. See "Technology to Cool Down Global Warming," Chemical Engineering, January 1999 (pp. 37-41). Because of these inherent advantages, Fischer-Tropsch technology is attracting increasing attention as a means for utilizing resources such as coal in efficient and environmentally friendly ways. Countries such as China and India, having large coal reserves and needs for liquid hydrocarbon fuels, could benefit immensely from such processes. See, e.g. Arthur W. Tower III, "Fischer-Tropsch Technology," published by Howard, Weil, Labouisse, Friedrichs of New Orleans, La., Dec. 18, 1998. See also "State of the Art in GTL Technology," presented by Dr. Joe Verghese of ABB Lummus Global at the Gas to Liquids World Forum, London, November 1998.

Summary of Invention Paragraph (29):

[0024] U.S. Pat. No. 4,549,396 (Mobil Oil) discloses a process of converting coal to synthesis gas by partial oxidation with air, then converting the synthesis gas to liquid and gaseous hydrocarbons. The gas and liquid products are both used in a gas turbine to generate electrical power.

Summary of Invention Paragraph (30):

[0025] U.S. Pat. No. 4,433,065 (Shell Oil) discloses a process for converting pulverized coal to a synthesis gas, which is catalytically converted to a gas containing hydrocarbons. Part of the product gases are recycled to the gasification stage.

Summary of Invention Paragraph (31):

[0026] U.S. Pat. No. 4,092,825 (Chevron Research) discloses a process of gasifying solid carbonaceous feedstocks to form a synthesis gas, a portion of which is contacted with a Fischer-Tropsch catalyst to form condensable hydrocarbons. A second portion of the synthesis gas can be combusted to generate electrical power, while the condensable hydrocarbons are used as fuel to generate more power to meet peak loads. This patent is a C.I.P. of U.S. Pat. No. 3,986,349.

Summary of Invention Paragraph (32):

[0027] U.S. Pat. No. 3,972,958 (Mobil Oil) discloses an integrated process for

converting coal to high octane gasoline by gasifying the coal to form a synthesis gas containing methane, then contacting the gas with at least one catalyst to form products including gasoline and light hydrocarbons.

Summary of Invention Paragraph (33):

[0028] Gray and Tomlinson of Mitretek Systems disclose in "CO.sub.2 Emissions from Fischer-Tropsch Fuels," presented at Fuels, Lubricants, Engines and Emissions meeting (sponsored by EFI and DOE) at Tucson, Ariz. on Jan. 18-20, 1999 a "coproduction cofeed" concept. Coal-derived synthesis gas is reacted in a liquid synthesis reactor to form liquid hydrocarbons, and unreacted synthesis gas is combined with natural gas for combustion in a downstream combined cycle power generation unit.

Summary of Invention Paragraph (34):

[0029] U.S. Pat. No. 5,324,335 (Applicants) discloses the use of Fischer-Tropsch liquids as a diesel fuel additive.

Summary of Invention Paragraph (35):

[0030] U.S. Pat. No. 5,500,449 (Applicants) discloses a method of recovering a heavy Fischer-Tropsch wax and thermally cracking the wax to produce diesel and naphtha fractions.

Summary of Invention Paragraph (36):

[0031] U.S. Pat. No. 5,504,118 (Applicants) discloses methods for manufacturing and activating iron-based Fischer-Tropsch catalysts.

Summary of Invention Paragraph (37):

[0032] U.S. Pat. No. 5,506,272 (Applicants) discloses Fischer-Tropsch diesel fuel products.

Summary of Invention Paragraph (38):

[0033] U.S. Pat. No. 5,543,437 (Applicants) discloses methods for producing Fischer-Tropsch products from coal-derived synthesis gas. The products are produced at varying rates due to varying amounts of the synthesis gas being fed to a power generation facility.

Summary of Invention Paragraph (39):

[0034] U.S. Pat. No. 5,620,670 (Applicants) discloses a process of producing synthesis gas in a steam reformer, reacting the synthesis gas in a Fischer-Tropsch reactor, then separating carbon dioxide and recycling same to the reformer to enhance carbon conversion efficiency and product yield.

Summary of Invention Paragraph (40):

[0035] U.S. Pat. No. 5,621,155 (Applicants) discloses methods of producing synthesis gas which is reacted in a Fischer-Tropsch reactor, then separating and recycling carbon dioxide to the steam reformer or partial oxidation reactor or recycling light hydrocarbons from the Fischer-Tropsch reactor to the reactor inlet, all to increase carbon conversion efficiency.

Summary of Invention Paragraph (41):

[0036] U.S. Pat. No. 5,645,613 (Applicants) discloses the use of Fischer-Tropsch liquids as a blending stock for diesel fuel to produce oxygenated diesel fuels.

Summary of Invention Paragraph (42):

[0037] Even though the technology for conversion of high-carbon feedstocks to synthesis gas and the subsequent production of Fischer-Tropsch liquids is well developed, the growing demand for energy coupled with the need to limit emissions of "greenhouse gases" and/or to sequester carbon dioxide which is emitted by combustion processes create a need for more efficient and flexible processes which can meet the demand for power and hydrocarbon production while separating carbon dioxide for sequestration or disposal.

Summary of Invention Paragraph (44):

[0038] It is an aspect of this invention to provide a Fischer-Tropsch process using an iron-based catalyst where the hydrocarbon-containing feedstock to the first stage gasifier has a much lower H:C ratio than natural gas which generally has a H:C ratio in the range of 3.0 to 4.0.

Summary of Invention Paragraph (46):

[0040] It is another aspect of this invention to produce a synthesis gas from carbon-bearing feedstocks having an H:C atom ratio of less than about 2.0 which can be used for combustion in boilers for the production of steam in an electric power generation system and when the demand for the electric production decreases, the synthesis gas can be used for a process for producing hydrocarbons having an average H:C atom ratio of 2.0 or greater.

Summary of Invention Paragraph (47):

[0041] The process produces hydrocarbons having an average H:C atom ratio of 2.0 or greater from carbon-bearing feedstocks having an H:C atom ratio of less than 2.0. The carbon-bearing feedstock is reacted with an oxidizing gas such as oxygen or air containing oxygen and steam in a partial oxidation reactor to produce a mixture of gases containing hydrogen and carbon monoxide having a molar ratio of H.sub.2:CO of greater than 0.6. Then the mixture of gases containing hydrogen and carbon monoxide is reacted in a Fischer-Tropsch synthesis reactor containing a catalyst which catalyzes both hydrocarbon-forming reactions and the water gas shift reaction. The product hydrocarbons are condensed out from the unreacted hydrogen, carbon monoxide and other gases referred to as tail gases.

Summary of Invention Paragraph (48):

[0042] The present invention allows the production of FT liquid hydrocarbons, electrical power and carbon dioxide, all from high-carbon feedstocks. The claimed apparatus and processes allow at least one of these outputs to be selectively maximized according to economic requirements. The process is aimed at future requirements when carbon dioxide sequestration may be required and there will be economic benefits to doing so. Under such conditions, the sacrifice of outputs of high value FT liquids and/or electrical power to preferentially produce carbon dioxide will be a necessary capability.

Summary of Invention Paragraph (50):

[0044] Iron catalyst: Iron-based catalysts allow the production of FT liquids from synthesis gases with low H.sub.2:CO ratios, such as obtained from high-carbon feedstocks. Also, iron catalysts are active towards the water-gas shift reaction, which produces carbon dioxide in the reactor product stream. Reducing the net carbon dioxide produced from high-carbon feedstocks is an increasingly important capability.

Summary of Invention Paragraph (52):

[0046] Hydrogen recycle: Hydrogen recycle from the FT product stream to the FT feed can optionally increase the H.sub.2:CO ratio of the synthesis gas fed to the FT reactor. This is beneficial, because although iron catalysts can handle low H.sub.2:CO ratio synthesis gas, higher H.sub.2:CO ratios produce less CO.sub.2 and greater yields of FT liquids. In addition, unless there is a local high-value market for hydrogen, it would be used to produce power. If power is higher valued than the hydrogen, less hydrogen would be recycled and more would be used to produce power. If a mixed FT product stream is acceptable, hydrogen would not be needed for hydrocracking, and it may be possible to eliminate the hydrogen removal step.

Summary of Invention Paragraph (53):

[0047] Process adjustability: The process can be operated to optimize the relative production rates of FT liquids, power and CO.sub.2. The FT reactor can be designed and operated (as to size and temperature, pressure and space velocity) to produce more or less FT liquids, and synthesis gas can be bypassed around the FT reactor directly to the combined cycle plant to produce more power or for load leveling. The production of carbon dioxide can be traded off against hydrocarbon production by altering catalyst operating variables such as temperature and space velocity. Additionally, the input of water to the FT reactor can be increased directly or by extracting less heat from the synthesis gas via the heat exchanger to increase CO.sub.2 production in the FT reactor.

Summary of Invention Paragraph (57):

[0051] a) reacting a carbon-bearing feedstock with an oxidizing gas and steam in a partial oxidation reactor to produce a mixture of gases containing hydrogen, carbon monoxide and carbon dioxide having a molar ratio of H.sub.2:CO of greater than about 0.6;

Summary of Invention Paragraph (58):

[0052] b) reacting the mixture of gases containing hydrogen and carbon monoxide in a Fischer-Tropsch synthesis reactor containing a catalyst which catalyzes both

hydrocarbon-forming reactions and the water gas shift reaction;

Summary of Invention Paragraph (59):

[0053] c) condensing the product hydrocarbons from unreacted hydrogen, carbon monoxide and other gases (tail gases);

Summary of Invention Paragraph (61):

[0055] e) removing at least a portion of carbon dioxide from the tail gases; and

Summary of Invention Paragraph (62):

[0056] f) producing steam from heat recovered from at least the partial oxidation reactor and the Fischer-Tropsch reactor, directing the steam to the steam turbine of a combined cycle plant, and directing at least the tail gases to the gas turbine of the combined cycle plant to produce power.

Summary of Invention Paragraph (63):

[0057] Optionally, hydrogen can be separated from the tail gases and utilized for recycle to the partial oxidation reactor and/or hydrocracking wax F-T products to form more liquid hydrocarbon products. Natural gas can be introduced into the partial oxidation reactor to supplement the feedstock. Natural gas can also be fed to the gas turbine of the combined cycle plant to increase power production. The production of carbon dioxide in the F-T reactor can be increased relative to hydrocarbon production by increasing the water content of the synthesis gas fed to the F-T reactor, preferably by decreasing the amount of heat extracted from the partial oxidation reactor effluent.

Summary of Invention Paragraph (66):

[0060] b) means for removing acid gases (such as H.sub.2S and COS) from the synthesis gas leaving the partial oxidation reactor;

Summary of Invention Paragraph (67):

[0061] c) a Fischer-Tropsch reactor connected to receive the synthesis gas;

Summary of Invention Paragraph (68):

[0062] d) heat exchangers connected to remove heat from the partial oxidation reactor, Fischer-Tropsch reactor and other heat sources and generate steam;

Summary of Invention Paragraph (70):

[0064] f) means for removing hydrocarbon products from the Fischer-Tropsch reactor effluent and separating them into fractions;

Summary of Invention Paragraph (71):

[0065] g) optionally, a hydrocracking reactor for utilizing hydrogen separated by (e) to hydrocrack wax fractions of the Fischer-Tropsch hydrocarbon products to form more liquid products; and

Summary of Invention Paragraph (72):

[0066] h) a combined cycle plant including gas and steam turbines for production of power from the steam and tail gases recovered from the partial oxidation reactor--Fischer-Tropsch reactor complex.

Detail Description Paragraph (9):

[0080] Suitable apparatus for removing acid gases such as H.sub.2S and COS from the synthesis gas produced by the partial oxidation reactor can be used. Suitable apparatus includes wet or dry scrubbing systems: an example is disclosed in U.S. Pat. No. 5,403,568, which is incorporated herein by reference.

Detail Description Paragraph (10):

[0081] Any suitable Fischer-Tropsch reactor capable of converting synthesis gases produced from heavy feedstocks to typical Fischer-Tropsch hydrocarbon products can be used. Typical reactors are disclosed in Rentech's U.S. Pat. Nos. 5,506,272; 5,543,437 and 5,763,716, which are incorporated herein by reference. Preferably, the Fischer-Tropsch reactor is a slurry reactor, such as disclosed in the above Rentech patents and described in the article entitled "Fischer-Tropsch Synthesis in Slurry Phase" by Schlesinger et al. in Engineering and Process Development, Vol. 43, No. 6 (June, 1951), pp. 1474-1479, and by Kolbel and Ralek in "The Fischer-Tropsch Synthesis in the Liquid Phase," Catalyst Review-Science Engineering, Vol. 21(2), pp. 225-274 (1980). Slurry reactors are vertical vessels in which fine powdered catalyst is suspended in molten wax. The synthesis gas is introduced into the bottom of the

reactor and F-T products emerge from the top and side of the reactor. The heavy F-T products are filtered from the wax/catalyst slurry.

Detail Description Paragraph (11):

[0082] The Fischer-Tropsch catalyst should be a catalyst which simultaneously catalyzes the production of hydrocarbon products from a synthesis gas and activates the water gas shift reaction. The catalyst is preferably an iron-based catalyst such as disclosed in U.S. Pat. No. 5,504,118, which is incorporated herein by reference. As stated in column 4 of the patent, the composition, preparation and activation of the catalyst are all important to its operation. The preferred catalyst is an unsupported precipitated iron catalyst promoted with copper and potassium, which is prepared using elemental iron and copper as starting materials. The catalyst can be prepared as disclosed in column 11 of the patent, and activated as disclosed in columns 12.

Detail Description Paragraph (12):

[0083] The H.sub.2 separation devices based on membranes are commercially available from Monsanto, W.R. Grace & Co., and Dow Corning. Another technology for H.sub.2 separation from a mixed gas stream uses pressure swing absorption (PSA). Suitable apparatus for separating carbon dioxide from tail gases include various absorption systems disclosed in U.S. Pat. Nos. 4,496,371; 4,957,715 and 5,424,051, which are incorporated herein by reference. Removal of carbon dioxide from the relatively high pressure gases emerging from the Fischer-Tropsch reactor at pressures in the range of from about 100 to about 500 psig, and temperatures in the range of from about 100.degree. to about 300.degree. F. is advantageous when compared with the alternative of removing the gas from atmospheric pressure stack gases from furnaces or other combustion systems, which typically contain less than 15 percent carbon dioxide. In the processes of the invention, the F-T reactor effluent can contain in the range of from about 15 to about 60 volume percent carbon dioxide, preferably from about 20 to about 55 and most preferably from about 25 to about 50 volume percent.

Detail Description Paragraph (14):

[0085] Optionally, a typical hydrocracking reactor is provided to utilize hydrogen separated from tail gases to crack wax products of the Fischer-Tropsch reactor into liquid hydrocarbons. Suitable hydrocracking reactors and catalysts are disclosed in U.S. Pat. Nos. 3,617,498; 4,197,184; 4,404,088; 4,501,655 and 5,026,472, which are incorporated herein by reference.

Detail Description Paragraph (15):

[0086] A suitable combined cycle plant is provided which includes at least one steam turbine to which steam recovered from the process can be fed, and a gas turbine to burn fuels which can include natural gas, tail gases from the Fischer-Tropsch reactor, hydrogen and naphthas separated from the hydrocarbon products. Such combined cycle plants are well known in the art.

Detail Description Paragraph (17):

[0088] The synthesis gas produced by the partial oxidation reactor 12 is passed to a Fischer-Tropsch reactor 28 via connectors 23 and 26. Preferably apparatus 24 for removing acid gases such as H.sub.2S and COS is included between the partial oxidation reactor 12 and Fischer-Tropsch reactor 28. Heat exchangers 22, 30 and 34 are provided to remove heat from the partial oxidation reactor, Fischer-Tropsch reactor and FT effluent connector 32, respectively. Additional heat exchangers (not shown) can be placed wherever the system offers a significant source of heat. All the heat exchangers are also steam generators, producing steam to drive the steam turbine(s) (not shown) of the combined cycle plant 68 via 70.

Detail Description Paragraph (19):

[0090] Tail gases 38 discharged from the hydrocarbon recovery unit 36 pass through optional hydrogen separation unit 50 and through carbon dioxide separation unit 58. Separated hydrogen is used by recycling to the Fischer-Tropsch reactor via connector 62 to increase the H.sub.2:CO ratio in the synthesis gas entering the F-T reactor and/or directed via connector 66 for hydrocracking wax products in hydrocracking reactor 78. A portion of tail gases 64 can pass directly to the combined cycle plant 68 for combustion in the gas turbine (not shown).

Detail Description Paragraph (22):

[0093] Combined cycle plant 68 is configured and connected to permit the employment of all available steam and combustible gases, and can be operated to maximize the

production of power when and where this is more valuable than the Fischer-Tropsch products. The principal feed for the gas turbine of this plant is tail gases 32 from the Fischer-Tropsch reactor (which may have been processed by further gas separators or the hydrocracking reactor). This fuel can be augmented by feeding natural gas 72 and/or naphtha fractions 42 of the F-T products to increase power production. The steam and gas turbines are connected to electrical generators to produce electrical power. To maximize power without production of F-T products, all the synthesis gas 73 from the POX can be sent to the gas turbine of combined cycle plant 68, thus bypassing F-T reactor 28.

Detail Description Paragraph (29):

[0097] In this flow sheet (FIG. 2) the F-T plant converts syngas from the gasifier into liquid hydrocarbons. Tail gas from the F-T plant is burned in the combined cycle plant to produce electricity. Steam from the three heat exchangers (22, 30, 34) is sent to the steam turbine part of the combined cycle plant 68 to produce electricity. Power production is maximized by burning the F-T naphtha and wax fractions in the combined cycle because these hydrocarbon products are generally of less value than the diesel fraction. This gives a power production of 271 MWe and a diesel production of 869 bbl/day. If the syngas from the gasifier is sent directly to the combined cycle, i.e., no hydrocarbons are produced via F-T reactions (Example 1A), the power production is 330 MWe. It could be argued that the latter configuration produces the maximum power, but in the absence of F-T hydrocarbon production.

Detail Description Paragraph (38):

[0102] In the flow sheet of FIG. 4, the yield of liquid hydrocarbons is maximized with two modifications from the flow sheet of FIG. 2. First, waxes 46 produced by the F-T reactor are hydrocracked to lighter hydrocarbon fractions. Second, a substantial fraction (95 percent) of the F-T tail gas 90 (mainly H.sub.2, CO.sub.2 and N.sub.2) is recycled to the gasifier. This large recycle rate is only feasible if CO.sub.2 is first removed from the recycle gas; otherwise excessive carbon would be fed to the gasifier. In this example, power production is 66 Mwe, liquid hydrocarbon production is 6365 bbl/day and CO.sub.2 production is 47 MMSCFD. Note that the CO.sub.2 production is the same as in that of Example 2, and that it cannot be adjusted downward without sacrificing hydrocarbon yield. However, the recycle rate and/or size of the F-T plant can be reduced to decrease the F-T product yield and increase power as needed.

CLAIMS:

1. A process for producing power, carbon dioxide and hydrocarbons having an average H:C atom ratio of 2 or greater from carbon-bearing feedstocks having an H:C atom ratio of less than 2, comprising the steps of: a) reacting a carbon-bearing feedstock with an oxidizing gas and steam in a partial oxidation reactor to produce a mixture of gases containing hydrogen, carbon monoxide and carbon dioxide having a molar ratio of H.sub.2:CO of greater than 0.6; b) reacting the mixture of gases containing hydrogen and carbon monoxide in a Fischer-Tropsch synthesis reactor containing a catalyst which catalyzes both hydrocarbon-forming reactions and the water gas shift reaction; c) condensing the product hydrocarbons from unreacted hydrogen, carbon monoxide and other gases (tail gases); d) separating the product hydrocarbons into naphtha, diesel and wax fractions; e) removing at least a portion of carbon dioxide from the tail gases; and f) producing steam from heat recovered from at least said partial oxidation reactor and said Fischer-Tropsch reactor, directing the steam to the steam turbine of a combined cycle plant, and directing at least the tail gases to the gas turbine of said combined cycle plant to produce power, wherein the process is operated to selectively maximize the production of at least one of the products power, Fischer-Tropsch hydrocarbons and carbon dioxide.

3. The process of claim 1 wherein acid gases are removed from the products of the partial oxidation reactor before they are passed to said Fischer-Tropsch reactor.

4. The process of claim 1 wherein hydrogen is separated from the tail gases and directed to at least one of: a) the Fischer-Tropsch reactor, and b) a hydrocracking reactor where wax products of the process are hydrocracked to form naphtha and diesel fractions.

6. The process of claim 1 wherein said Fischer-Tropsch reactor is a slurry reactor.

7. The process of claim 1 wherein said Fischer-Tropsch catalyst is an iron catalyst.

14. The process of claim 1 wherein said Fischer-Tropsch reactor is a slurry reactor.

15. The process of claim 1 wherein the production of Fischer-Tropsch hydrocarbons is maximized by separating hydrogen from the tail gases, recycling a portion of the hydrogen to the Fischer-Tropsch reactor, utilizing the remainder of said hydrogen to hydrocrack wax products in a hydrocracking reactor, and directing all of said mixture of hydrogen and carbon monoxide to said Fischer-Tropsch synthesis reactor.

16. The process of claim 1 wherein power production is maximized while producing Fischer-Tropsch hydrocarbons by directing all tail gases to said gas turbine and directing at least the wax and naphtha fractions of said hydrocarbons to said gas turbine.

17. The process of claim 1 wherein power production is maximized while producing Fischer-Tropsch hydrocarbons by introducing natural gas to the gas turbine of said combined cycle plant.

18. The process of claim 1 wherein the production and separation of carbon dioxide are maximized by increasing the water content of the synthesis gas introduced to said Fischer-Tropsch reactor.

20. The process of claim 1 wherein the production and separation of carbon dioxide are maximized by recycling up to about 90 percent of the Fischer-Tropsch tail gases to the inlet of said Fischer-Tropsch reactor.

21. The process of claim 1 wherein said Fischer-Tropsch reactor is a slurry reactor.

22. Apparatus for producing power, carbon dioxide and hydrocarbons having an average H:C atom ratio of 2 or greater from carbon-bearing feedstocks having an H:C ratio of less than 2, comprising: a) a partial oxidation reactor for reacting a carbon-bearing feedstock with an oxidizing gas and steam to produce a mixture of gases containing hydrogen, carbon monoxide and carbon dioxide, having a molar ratio of H.sub.2:CO of greater than 0.6; b) a Fischer-Tropsch synthesis reactor for reacting the mixture of gases containing hydrogen and carbon monoxide, said reactor further containing a catalyst which catalyzes both hydrocarbon-forming reactions and the water gas shift reaction; c) means for transporting the gases from the partial oxidation reactor to the Fischer-Tropsch synthesis reactor; d) means for condensing the product hydrocarbons from the Fischer-Tropsch synthesis reactor from unreacted hydrogen, carbon monoxide and other gases (tail gases); e) means for separating the product hydrocarbons into suitable fractions; f) means for separating at least one of hydrogen and carbon dioxide from the tail gases; g) means for recycling at least a portion of the separated hydrogen to the inlet of the partial oxidation reactor; h) means for recovering heat from at least the partial oxidation and Fischer-Tropsch reactors and generating steam; and i) a combined cycle plant comprising gas and steam turbines for the production of power from products generated by the Fischer-Tropsch reactor and the steam generated in (h).

24. The apparatus of claim 22 wherein said Fischer-Tropsch synthesis reactor is a slurry reactor.